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# A new troglomorphic species of *Austrochthonius* (Pseudoscorpiones: Chthoniidae) from Australia, with remarks on *Chthonius caecus*

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**Abstract** – A new species of the chthoniid genus *Austrochthonius* Chamberlin is described and named from the Ludlow region of southern Western Australia. *Austrochthonius strigosus* sp. nov. exhibits some strong troglomorphic adaptations such as eye loss, elongate pedipalps and pallid colouration. *Chthonius caecus* Tullgren, 1909, a junior homonym, and its replacement name *Sathrochthonius tullgreni* Chamberlin, 1962, are transferred to *Austrochthonius*. A new replacement name, *Austrochthonius muchmorei*, is provided, as *A. tullgreni* is a junior secondary homonym of *A. tullgreni* (Beier, 1931).

## INTRODUCTION

The chthoniid genus *Austrochthonius* possesses a typical Gondwanan distribution with eight species recorded from southern South America, three species from New Zealand, three species from Australia, one species from the Îles Crozet, and one species from South Africa (Harvey 1991a, 1991c; Judson 2001). The Australian fauna consist of *Austrochthonius australis* Hoff from southern Australia and two troglobitic species from caves in the Naracoorte region, South Australia (*A. cavicola* Beier) and Cape Range peninsula, Western Australia (*A. easti* Harvey). Kennedy (1990) presented a redescription of *A. australis* based upon large quantities of material from south-eastern Australia and noted that the Western Australian specimens attributed to *A. australis* by Beier (1966a) were sufficiently different from *A. australis* that they represented a distinct species. An additional species from the Kimberley region of Western Australia was reported by Harvey (1991b) but it currently remains undescribed.

Epigean members of *Austrochthonius* in Australia can be quite common in leaf litter and soil, but the troglobitic species are relatively uncommon with just a few specimens collected. Whilst considerable work is needed to unravel the systematic relationships of the genus within Australia, we are here describing a new troglomorphic species of the genus that has been recovered from subterranean sampling undertaken in the Ludlow area near Busselton, south-western Australia. Although only a single male has been collected, it is sufficiently distinct from all other species of the genus that we have prepared a systematic description to formally record this unusual species in the scientific literature. We also comment on the species first named as *Chthonius caecus* Tullgren from south-western Australia (Tullgren 1909) which has since been transferred to the genus *Sathrochthonius* Chamberlin and renamed *S. tullgreni* (Chamberlin, 1962). We suggest that this species is in fact a species of the genus *Austrochthonius*.

## MATERIAL AND METHODS

The material utilized in the present study is lodged in the Western Australian Museum, Perth (WAM). Terminology and mensuration mostly follows Chamberlin (1931), with the exception of the nomenclature of the pedipalps, legs and with some minor modifications to the terminology of the trichobothria (Harvey 1992). In particular, it should be noted that the terminology for the trichobothria used by Harvey (1992) differs slightly from that used by other workers.

The specimen was examined by preparing a temporary slide mounts by immersing the specimen in 75% lactic acid at room temperature for several days, and mounting it on a microscope slide with 10 mm coverslips supported by small sections of 0.25 mm or 0.50 mm diameter nylon fishing line. It was examined with an Olympus BH-2 compound microscope and illustrated with the aid of a drawing tube. Measurements were taken at the highest possible magnification using an ocular

graticule. After study the specimen was returned to 75% ethanol with the dissected portions placed in 12 x 3 mm glass genitalia microvials (BioQuip Products, Inc.).

## SYSTEMATICS

### Family Chthoniidae Daday

### Subfamily Chthoniinae Daday

### Genus *Austrochthonius* Chamberlin

*Austrochthonius* Chamberlin, 1929: 68. Type species: *Chthonius chilensis* Chamberlin, 1923, by original designation.

*Paraustrochthonius* Beier, 1931: 52 (synonymised by Beier, 1976: 203). Type species: *Paraustrochthonius tullgreni* Beier, 1931, by original designation.

*Cecoditha* Mello-Leitão, 1939: 115–116 (synonymised by Judson, 2001: 142). Type species: *Cecoditha parva* Mello-Leitão, 1939, by original designation.

#### Remarks

*Austrochthonius* belongs to a group of genera characterised by the presence of coxal spines only on coxa II and that lack one or more enlarged spine-like setae on the interno-basal margin of the chelal hand. Defined in this way, this group currently includes nine genera: *Austrochthonius*, *Chiliochthonius* Vitali-di Castri, *Drepanochthonius* Beier, *Francochthonius* Vitali-di Castri, *Maorichthonius* Chamberlin, *Malcolmochthonius* Benedict, *Mexichthonius* Muchmore, *Mundochthonius* Chamberlin and *Tyrannochthoniella* Beier. The African genus *Congochthonius* Beier was also attributed by Muchmore (2001) to a group containing some of these genera but the affinities of this unusual genus appear to lie with *Sathrochthonius* Chamberlin and *Sathrochthoniella* Beier due to a small suite of morphological features of which the most prominent is the sub-basal position of trichobothria *ib* and *isb*.

Six genera of the *Austrochthonius* group occur in the southern hemisphere, whereas three genera occur in the northern hemisphere. *Austrochthonius* species are found on all of the southern continents (Harvey 1996), as well as the Îles Crozet (Vitali-di Castri 1968); species of *Chiliochthonius*, *Drepanochthonius* and *Francochthonius* are restricted to Chile (Beier 1964a; Vitali-di Castri 1976); and the genera *Maorichthonius* and *Tyrannochthoniella* are endemic to New Zealand (Beier 1976). The three Laurasian genera, *Mundochthonius*, *Malcolmochthonius* and *Mexichthonius*, occur in North America, whilst species of *Mundochthonius* have also been recorded from Europe and East Asia (summarized by Harvey 1991a), with subsequent species recently named by Kim and Hong (1994), Muchmore (1996), Sakayori (2002), Dashadamirov (2005) and Zaragoza and Harvey (2006). The relationships and status of some of these genera is doubtful and some rationalisation may be expected in the future.

### *Austrochthonius strigosus* sp. nov.

Figures 1–5

#### Material Examined

*Holotype*

♂, Ludlow region (site LDMB2, 33.58921503°S, 115.4904651°E), 33°35'21"S, 115°29'26"E, Western Australia, Australia, 18 November 2004, from borehole at approximately 5 m depth, L. Mould and D. Kamien (WAM T65550).

#### Diagnosis

*Austrochthonius strigosus* differs from all previously named species of the genus by the elongate pedipalpal chela which is 6.35 times longer than broad in the holotype male, but less than 5.4 times longer than broad in other species (Table 1).

#### Description

*Adult male (holotype, WAM T65550):* Colour generally pale yellow-brown, legs slightly paler than body.

*Chelicera*: with 5 setae on hand and 1 medial seta on movable finger (Figure 3); fixed finger with 5 small teeth, of approximately same size; movable finger slightly shorter than hand, with 4 small teeth and 2 extremely small teeth; blades of the flagellum not clearly visible; galea a short rounded nubbin.

*Pedipalp*: trochanter 1.73, femur 4.95, patella 1.89, chela 6.35, chelal hand 2.17 times longer than broad; movable chelal finger 1.90 times longer than hand; fixed chelal finger with 69 teeth, moveable chelal finger with 55 teeth, all teeth closely spaced and either gently rounded or slightly truncate (Figure 1); fixed chelal finger and hand with 8 trichobothria, movable chelal finger with 4 trichobothria (Figures 1, 2); *ib* and *isb* situated sub-medially on dorsum of chelal hand; *eb* and *esb* situated sub-laterally at base of chelal fingers; *xs* situated slightly distal to *et* near tip of fixed finger, each hair shorter than those of other trichobothria; *b* situated slightly closer to *t* than to *sb*; *sb* closer to *b* than to *st*; venom apparatus absent.

*Carapace*: 1.05 times longer than broad; without eyes; anterior margin finely denticulate with very distinct and strongly toothed epistome (Figure 5); with 18 setae arranged 6: 4: 4: 2: 2; the pre-ocular seta about 50% length of other setae in anterior row;

**Table 1** Species of *Austrochthonius*, with distributions and pedipalpal chela ratios.

| Species | Distribution | Ratio of pedipalpal chela length/width | Reference |
|---|---|---|---|
| *A. argentinae* Hoff | South America | 4.81 (female) | (Hoff ,1950) |
| *A. australis* Hoff | Australia | 4.07 (female) | (Hoff, 1951) |
| | | 4.1 (adult) | (Beier, 1966a) |
| *A. bolivianus* Beier | South America | 4.2 (adult) | (Beier, 1932) |
| *A. cavicola* Beier | Australia | 5.2 (male) | (Beier, 1967a) |
| *A. chilensis chilensis* (Chamberlin) | South America | 4.30 (female) | (Chamberlin, 1923) |
| *A. chilensis magalhanicus* Beier | South America | not stated | (Beier, 1964a) |
| *A. chilensis transversus* Beier | South America | 5.4 (male) | (Beier, 1964b) |
| | | 4.8 (female) | |
| *A. easti* Harvey | Australia | 4.17 (male) | (Harvey, 1991c) |
| *A. iguazuensis* Vitali-di Castri | South America | 2.82 (female) | (Vitali-di Castri, 1975) |
| *A. insularis* Vitali-di Castri | Îles Crozet | 4.4 (female) | (Vitali-di Castri, 1968) |
| *A. mordax* Beier | New Zealand | 5.2-5.3 (male) | (Beier, 1967b) |
| | | 4.5 (female) | |
| *A. paraguayensis* Vitali-di Castri | South America | 3.54 (male) | (Vitali-di Castri, 1975) |
| *A. parvus* (Mello-Leitão) | South America | 5.3 (male) | (Judson, 2001) |
| *A. persimilis* Beier | South America | 4.0 (female) | (Beier, 1964a) |
| *A. rapax* Beier | New Zealand | 4.2 | (Beier, 1976) |
| *A. semiserratus* Beier | South America | 4.64 (female) | (calculated from Beier, 1930, fig. 11a) |
| *A. strigosus* sp. nov. | Australia | 6.35 (male) | this paper |
| *A. tullgreni* (Beier) | South Africa | 4.6 (adult) | (Beier, 1931) |
| *A. zealandicus zealandicus* Beier | New Zealand | 4.9–5.2 (male) | (Beier, 1967b) |
| | | 4.1–4.4 (female) | (Beier, 1966b) |
| *A. zealandicus obscurus* Beier | New Zealand | 4.0 (adult) | (Beier, 1966b) |

with 3 pairs of lyrifissures, one pair situated antero-medially, the second pair situated interno-lateral to the "ocular" region, and the third pair situated exterior to the sole pair of setae of the posterior row.

*Coxal region*: coxal chaetotaxy: 2+3: 3 + 2m: 4: 5: 5 (Figure 4); manducatory process with 2 acuminate distal setae, about equal in length to each other; pedipalpal coxa without dorsal setae; intercoxal tubercle absent; coxa I without apical projection, but with 2 small microsetae (m) situated on distal margin; other setae on coxa I situated near trochanteral foramen (Figure 4); coxal spines present only on coxa II, 6 (left coxa) or 7 (right coxa) bipinnate spines present, bases not contiguous (Figure 4).

*Legs*: femur+patella IV 2.84 times longer than deep; heterotarsate; arolium slightly shorter than claws, claws simple.

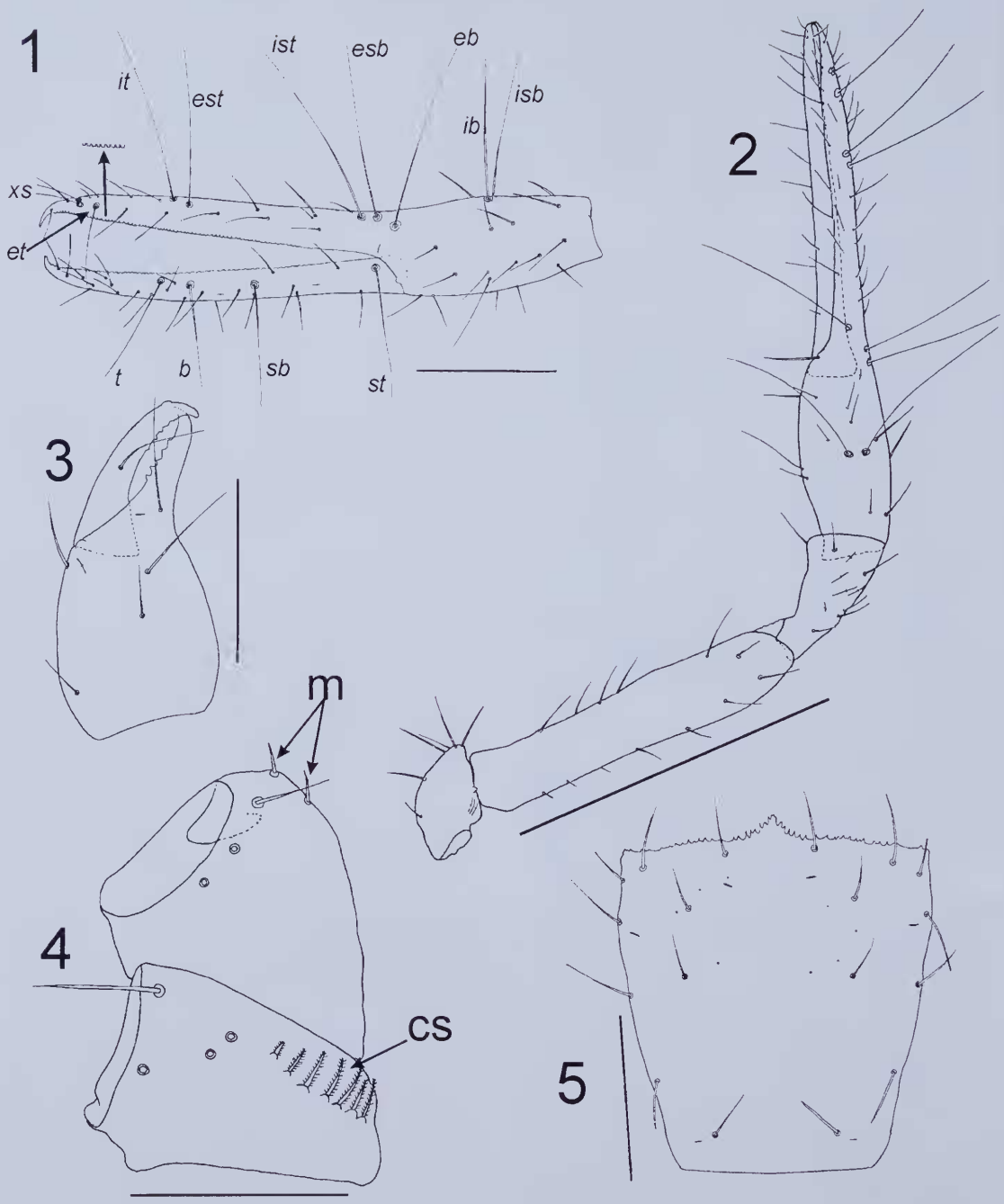
*Abdomen*: tergites and sternites undivided; tergal chaetotaxy, 4: 4: 4: 4: 5: 6: 6: 6: 6: 6: 6: 0; sternal chaetotaxy, 10: (1) 26 (1): (2) 7 [4+4] (2): 9: 8: 8: 8: 8: 8: -: 2. All setae bordering sternite III acuminate. Genitalia of male not studied in detail (due to poor preservation), but 4 pairs of stout glandular setae present within genital atrium. Pleural membrane evenly plicate.

**Dimensions (mm)**

*Holotype male (WAM T65550)*: Body length 1.184. Pedipalps: trochanter 0.176/0.102, femur 0.505/0.102, patella 0.217/0.115, chela 0.768/0.121, hand length 0.262, movable finger length 0.499. Chelicera 0.352/0.169, movable finger length 0.195. Carapace 0.403/0.384. Leg I: femur 0.280/0.054, patella 0.131/0.051, tibia 0.150/0.041, tarsus 0.438/0.141. Leg IV: femur + patella 0.417/0.147, tibia 0.301/0.069, metatarsus 0.146/0.052, tarsus missing.

Remarks

The single specimen was taken from a bore at a depth of approximately 5 m during sampling targeting stygofauna in the region. The pseudoscorpion was collected in a sample raised to the surface using a modified plankton net and collection jar, lowered into a borehole through a 50 mm diameter piezometer (a non-pumping well, generally of small diameter, for measuring the elevation of a water table or for other groundwater monitoring) within limestone sediments in the Ludlow region. Additional wells were sampled in the area by the junior author and, despite several sampling attempts in the region, no further specimens were obtained. Thus, at present, *A. strigosus* is known only from a single karst location situated in south-western Australia. The type locality comprises open woodland composed of Tuart (*Eucalyptus gomphocephala*, Myrtaceae) and Peppermint (*Agonis flexuosa*, Myrtaceae) with an understorey dominated by weeds including Arum Lily (*Zantedeschia aethiopica*, Araceae) and introduced grasses on a floor of dense leaf litter and sandy soil.




**Figures 1–4** *Austrochthonius strigosus* sp. nov., holotype male. 1, left chela, lateral view. 2, right pedipalp, dorsal view. 3, left chelicera, dorsal view. 4, right coxae I and II (abbreviations: ca = coxal spines; m = microsetae). 5, carapace, dorsal view. Scale lines = 0.10 mm (Figure 4), 0.20 mm (Figures 1, 3, 5), 0.50 mm (Figure 2).

The holotype is slightly macerated and covered in a fine sediment which is consistent with the specimen spending some time after death in the water within the bore, or at least on the surface of the water column. It is lacking several legs and the distal segments are missing on others.

On the basis of the total lack of eyes (Figure 5) and the strongly elongated pedipalpal segments (Figures 1, 2), *A. strigosus* is clearly the most troglomorphic species thus far recognized in the genus. The only other cave-dwelling species, *A. cavicola* from the Naracoorte Caves, South Australia and *A. easti* from the Cape Range Caves, Western Australia, possess less elongate pedipalpal segments. Although both *A. strigosus* and *A. cavicola* completely lack eyes (Beier, 1968), *A. easti* has a single pair of small anterior eyes (Harvey, 1991c). All epigean species of the genus, with the exception of the blind *A. iguazuensis*, either possess two pairs of eyes or a single pair of eyes.

*Austrochthonius strigosus* satisfies the criteria discussed by Harvey (2002) to be considered as a short-range endemic species. It has an exceedingly small distribution and occurs in such a specialised habitat – karst within the Ludlow region – that the total area of occupancy is likely to be minimal.

**Etymology**

The specific epithet denotes the slender pedipalpal chela (*strigosus*, Latin, lean, thin).

***Austrochthonius muchmorei* nom. nov.**

*Chthonius caecus* Tullgren, 1909: 414–415, figure 3 [junior primary homonym of *Chthonius coecus* Packard, 1884 and *Chthonius caecus* Simon, 1885].

*Mundochthonius (?) caecus* (Tullgren): Beier 1932: 38; Roewer 1937: 238.

*Mundochthonius caecus* (Tullgren): Nicholls 1933: 111; Chamberlin, 1934: 3; Weidner 1959: 115.

*Sathrochthonius tullgreni* Chamberlin, 1962: 306–307 [replacement name for *Chthonius caecus* Tullgren; junior secondary homonym of *Austrochthonius tullgreni* (Beier, 1931)]; Harvey 1981: 241; Harvey 1985: 140–141; Harvey 1991a: 202.

*Sathrochthonius (?) tullgreni* Chamberlin: Beier, 1966a: 276; Muchmore 1982: 158.

**Remarks**

Tullgren (1909) described *Chthonius caecus* based upon a single male collected from Brunswick (a small town to the south of Perth that is now called Brunswick Junction, 33°15'S, 115°50'E) during the Michaelsen and Hartmeyer Expedition on 7 October 1905. The specimen was doubtfully transferred to the genus *Mundochthonius* by Beier (1932: 38) who reported that the specimen was lost ("Type verloren gegangen"). Weidner (1959) reported that the specimen was lost in July 1930 from the Zoologisches Institut und Zoologisches Museum, Universität Hamburg Germany, which has been recently confirmed for us by Dr Hieronymus Dastych (in litt., 17 May 2006). Chamberlin (1962) speculated on the identity of *C. caecus* and tentatively transferred it to his newly formed genus *Sathrochthonius*, also noting that it was a junior primary homonym of both *C. coecus* Packard, 1884 and *C. caecus* Simon, 1885 (International Commission on Zoological Nomenclature, 1999, Article 58). To resolve the homonymy, Chamberlin (1962) provided the replacement name *S. tullgreni*. Beier (1966a) and Muchmore (1982) doubted that Chamberlin's generic placement of this species was correct, the former by including a question mark after the generic name [*Sathrochthonius (?) tullgreni*], and the latter by stating that "there is no way to determine the identity of this species until topotypic material ... is studied."

The speculation that Tullgren's specimen was a member of the genus *Sathrochthonius* is here believed to be erroneous, and we suggest that it is better placed in the genus *Austrochthonius*. The original description by Tullgren (1909) clearly illustrates a specimen with straight chelal fingers (when viewed dorsally). The chelal fingers of *Sathrochthonius* species are gently but unquestionably curved (e.g., Chamberlin 1962, fig. 1b; Muchmore 1982, fig. 2), whereas species of *Austrochthonius*, as well as many other chthoniids, possess straight or nearly straight chelal fingers. Furthermore, whilst members of *Austrochthonius* are quite common throughout south-western Australia, species of *Sathrochthonius* are very rare. Indeed, the only records of *Sathrochthonius* from the region are of an unnamed species from Quininup (34°28'S, 116°15'E) (WAM 80/1373), West Cape Howe (35°08'S, 117°36'E) (WAM 89/363-364) and Warren National Park near Pemberton (34°27'S, 116°02'E) (WAM 80/1151-1153). The only other chthonioids in the region are *Lagynochthonius australicus* (Beier) which occurs in high rainfall regions along the south coast of Western Australia, and several species of *Pseudotyrannochthonius* which are found in a variety of disjunct locations in the area (Harvey, unpublished data). The description of *C. caecus* by Tullgren (1909) clearly demonstrates that it does not belong to either of these genera.

Based upon this reasoning, we here transfer *Chthonius caecus* Tullgren and the replacement name *Sathrochthonius tullgreni* Chamberlin to *Austrochthonius*. Unfortunately this species then becomes a junior secondary homonym of *Austro-*

*chthonius tullgreni* (Beier, 1931) from South Africa. Therefore a replacement name, *A. muchmorei*, is here proposed.

It is beyond the scope of this paper to provide a complete description of *A. muchmorei* as there is more than one species of *Austrochthonius* occurring in leaf litter and soil within south-western Australia (Harvey, unpublished data) and there are considerable difficulties in determining suitable species level boundaries amongst this assemblage.

**Etymology**

This species is named for William B. Muchmore, in recognition of his outstanding contribution to pseudoscorpion systematics over a 40-year period. He also suggested that *S. tullgreni* may be misplaced in *Sathrochthonius*.

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